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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/605,377	09/25/2003	Jun-Cheng Lai	LKSP0022USA	2376

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NORTH AMERICA INTERNATIONAL PATENT OFFICE (NAIPC)
P.O. BOX 506
MERRIFIELD, VA 22116

EXAMINER

ROSASCO, STEPHEN D

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 08/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/605,377

Applicant(s)

LAI, JUN-CHENG

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 August 2004.
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 1-16 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☒ The drawing(s) filed on 25 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 8/18/04.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

The disclosure is objected to because of the following informalities: section [0013], line 5, "includes to provide".

Appropriate correction is required.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen (6,274,281) or Lin et al. (6,077,633).

The claimed invention is directed to a lithography method for forming a plurality of closed patterns in a photoresist layer on a substrate, the patterns being isolated from each other and being arranged in an array, the lithography method comprising: providing a phase shift mask (PSM), wherein the phase shift mask comprises: a plurality of first phase shift transparent regions; a plurality of second phase shift transparent regions having a phase shift relative to the first phase shift transparent regions; and a non-phase shift region, wherein the first phase shift transparent regions and the second phase shift transparent regions are regularly interlaced in an array, and each of the first phase shift transparent regions and each of the second phase shift transparent regions are separated by the non-phase shift region; and performing an exposure process to form the closed

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patterns in the photoresist layer, wherein the closed patterns are corresponding to the first phase shift transparent regions and the second phase shift transparent regions.

And wherein the closed pattern is selected from the group consisting of a contact hole pattern and a logic cell pattern of a logic circuit.

And wherein the phase shift mask is an alternate phase shift mask.

And wherein the non-phase shift region is a not completely transparent region, and a transmittance of the non-phase shift region is selected from the group consisting of 6%, 9%, 18%, and 20%.

The applicant discusses the limitations of the prior art in that when assist features are utilized to improve the resolution of the contact hole patterns, the resolution is not improved if the patterns to be formed are too small. Moreover, the contact hole patterns, that should be separated from each other, may connect together after the lithography process. In fact, a ratio of the spacing between the patterns to be formed to a line width of the patterns to be formed must be greater than $1/2$ when using this method. When utilizing the half-tone mask to improve the resolution of the contact hole patterns, the light intensity of the side-lobe is too high to produce extra patterns if the transmittance of the embedded layer is too high. If the transmittance of the embedded layer is too low, the destructive interference of light caused by the phase shift is not enough. The side-lobe phenomenon at the edge of patterns cannot be eliminated, leading to the unsatisfied pattern edge resolution.

Chen teaches a contact hole mask, comprising: a transparent mask substrate having a first number of first contact hole regions and a second number of second contact hole regions wherein each of said first contact hole regions have a first width and a first outer

perimeter and each of said second contact hole regions have a second width and a second outer perimeter;

a first thickness of light absorbing material formed on that part of said transparent mask substrate not covered by said first number of first contact hole regions and said second number of second contact hole regions, wherein said first thickness of said light absorbing material has a first transmittance;

a second thickness of said light absorbing material formed on each of said first contact hole regions of said transparent mask substrate, wherein said second thickness of said light absorbing material has a second transmittance; and

a third thickness of transparent phase shifting material formed on said first thickness of said light absorbing material covering that part of said transparent mask substrate not covered by said first number of first contact hole regions and said second number of second contact hole regions, wherein said third thickness of said transparent phase shifting material produces a phase shift of 180 degree.

Lin et al. teach a contact hole mask, comprising: a transparent mask substrate having a first region and a second region;

a patterned layer of attenuating phase shifting material formed on said transparent mask substrate, wherein said patterned layer of attenuating phase shifting material has first holes and second holes formed therein, said first holes are over said first region of said transparent mask substrate, and said second holes are over said second region of said transparent mask substrate; and

a patterned layer of opaque material formed on said patterned layer of attenuating phase shifting material, wherein said patterned layer of opaque material has first holes and second holes formed therein, said first holes in said patterned layer of opaque material have the same size and shape as said first holes in said layer of attenuating phase shifting materials said first holes in said opaque material are directly over said first holes in said attenuating phase shifting material, said second holes in said opaque material are directly over said second holes in said attenuating phase shifting material, and said second holes in said opaque material are larger than said second holes in said attenuating phase shifting material thereby exposing a gap width of said attenuating phase shifting material around the periphery of said second holes in said layer of attenuating phase shifting material.

And wherein said attenuating phase shifting material is MoSiON.

And wherein said attenuating phase shifting material provides a 180.degree. phase shift for light having a wavelength of between about 193 and 248 nanometers.

And wherein said attenuating phase shifting material transmits between about 4% and 6% of the incident light intensity for light having a wavelength of between about 193 and 248 nanometers.

And wherein said first holes in said attenuating phase shifting material and said opaque material are used to form contact holes in an integrated circuit wafer wherein the distance between the periphery of adjacent said contact holes is between about 0.18 and 0.25 micrometers.

And wherein said first transmittance is between about 4% and 20% and said second transmittance is between about 90% and 99%.

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The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Wu (6,759,328).

Wu teaches an exposure method of a contact hole, comprising: providing a mask including a transparent substrate, a phase shift layer installed on the transparent substrate to define a series of patterns having contact hole areas arranged in array, and a plurality of metal lines installed on the phase shift layer between the adjacent contact hole areas, wherein the pitch between the contact hole areas is about 300.about.600 nm and performing an exposure by transmitting a light source through the mask after the metal lines absorb high degree diffraction waves; wherein the metal lines are substantially thinner than the pitch between the contact hole areas, equidistant from the contact holes, and installed on the phase shift layer in an orthogonal grid pattern.

And wherein the contact hole area is about 100 to about 300 nm, and the metal lines comprise Chrome, and the phase shift layer comprises MoSiON.

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Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866 217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, looped flourish at the end.

S. Rosasco
Primary Examiner
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S. Rosasco
07/28/05